Weapon System Open Experimental Platform

Dave Sharp
Dick Buchness
Wendy Roll

Experimentation Team Leaders
Mike Effinger, ***CMU***
Ed Pla, ***Honeywell***
Mark Schulte, ***Vanderbilt***

Joe Hoffert, ***Instrumentation Interface***

Outline

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1: Administrative

- **Title**
  - Open Experimental Platform For The Model-Based Integration of Embedded Software Program
- **PM**
  - Don Winter
- **PI**
  - Dave Sharp, 314-233-5628, david.sharp@boeing.com
- **Co-PI**
  - Dick Buchness, 562-593-0452.
- **Company**
  - Boeing
- **Contract**
  - F33615-00-C-1704
- **Award End Date**
  - June 2005

2: Subcontractors and Collaborators

- **Subcontractors**
  - **Object Computing, Inc (new)**
    - **OVATION: Object Viewing and Analysis Tool for Integrated Object Networks**
- **Collaborators**
  - **Related DARPA programs, especially**
    - **SEC, PCES, NEST**
  - **For MoBIES, SEC, and PCES:**
    - **We are developing a "Common OEP" that shares applicable**
      - **OEP baselines**
      - **Approaches**
        - **Challenge Problems**
        - **Product/Development Scenario-based experimentation**
    - **Goals**
      - **Leverage OCP/OEP investments across programs**
      - **Facilitate technology transition**
  - **Production programs discussed under "Transition"**

3: Problem Description and Program Objective

- **Problem Description**
  - Provide Weapon System OEP for MoBIES
- **Program Objective**
  - Provide a full range of collaborative transitionable
    - MoBIES-related technology challenges,
    - Run-time platforms and applications, and
    - Experiments, evaluations, and demonstrations.
  - And facilitate transition of promising technologies into production use
  - Success criteria
    - Transition of radically improved embedded software component integration tools and techniques into military system development programs

7: Project Status

- **Primary Activities**
  - Completion of mid-term experiments
  - Definition of initial Instrumentation Interface
  - Release of Builds 2.0 and 2.1
- **Related Activities**
  - Release of OEP Build 1.6 for PCES Program, 2 April 2002
    - Adds Product Scenarios associated with
      - Concurrency
      - Correlation
      - Persistence

MoBIES Build 2.0

- **Released 24 June 2002**
- **Product Scenarios**
  - **New Representative Single Processor (PS 2.1)**
    - **Instantiates 416 components**
    - **New component types**
      - **Product specific components in Operator and Real World Model layers**
      - **“Container” components that manage a set of components**
      - **Dynamically created/destroyed components using Heap Management Utilities**
      - **Modal components that suspend and resume event consumption**
    - **OEP Configuration Interface augmented for internal component variability**

MoBIES Build 2.0 (cont)

- **Product Scenarios (cont)**
  - **For Windows, Linux**
    - **Frame overruns on VxWorks depending on hardware performance**
  - **All other scenarios**
    - **Ported to VxWorks Power PC platform**
- **Run Time Instrumentation**
  - **Output conforms to Instrumentation Interface**
  - **Output produced on Linux platform**

MoBIES Build 2.0

- **Product Scenario Description Updates**
  - **New requirements section for each PS**

1.1.1 Requirements

Functionally, the system must update navigation displays with timely airframe position information using inputs from navigation sensors. Concurrently, there is also a device that captures the pilot's cursor position that is a point of interest for weapon release. When the position of the cursor updates, the position on the tactical display must be updated.

Following sections describe specific requirements associated with both inputs and outputs for this product scenario.

1.1.1.1 Input Requirements

The system shall request new inputs from the GPS subsystem at a 40 Hz rate.

The system shall poll an input cursor representing a potential weapon target point at a 20 Hz rate.

1.1.1.2 Output Requirements

The system shall update the display outputs with new aircraft position data at a 40 Hz rate. The latency between associated inputs and this output shall be less than a single 40 Hz frame.

The system … w point data is availa…

Capture All Representative Execution Combinations

MoBIES Build 2.1

- Released 23 July 2002
- Includes
  - Infrastructure Frame Controller to align processing frames
    - Existing scenarios altered to use new frame controller
  - 1.9 Frame overrun SP scenario
    - Altered OM1__FormatComponent to set processing time “dial” specified through OEP Configuration Interface
    - ~80 components
    - Runs on Windows, Linux, and VxWorks/PowerPC platforms
  - Instrumentation Interface output for all Product Scenarios on VxWorks/PowerPC included

External Collaborations

- **Publications**
  - **"Model-Based Integration of Reusable Component-Based Avionics Systems"**
    - **Software Technology Conference, 1 May 2002**
    - **To be delivered at Boeing Technical Excellence Conference 1 August**
  - **"Towards Model-Based and CCM-Based Applications for Real-Time Systems"**
    - **OMG Real-Time Embedded Workshop, 18 July 2002**

External Collaborations (cont)

- **DARPA PCES Program**
  - **Several PCES Applied Researchers are using existing MoBIES Challenge Problems for language-based configuration approaches**
    - **Kansas State University**
      - **Developing event dependency and concurrency languages and analysis capabilities**
    - **Oregon Graduate Institute**
      - **Developing procedural Domain Specific Language for component configuration**
    - **Stanford University**
      - **Developing richer language for event correlation along with code generation capabilities to integrate component mode logic into event service**
  - **Interested in investigating integration of model-based and language-based approaches**

Challenge Problems

- **Increasing Breadth**
  - **Continue Working on Unaddressed MoBIES Challenge Problem Requirements**
    - **View integration**
    - **Fault management**
    - **Event analysis**
    - **Product line reuse support**
      - **Internal component configurability in Build 2.0**

Requirements Covered By Mid-Terms

Challenge Problem Requirements	CMU	Honeywell	Vanderbilt
Logical Fault Management			
MLF01			
MLF02			
MLF03			
Threading			
MTH01			
MTH02			
MTH03			
Event Dependency			
MEV01			
MEV02			
MEV03			
MEV04			
Mapping			
MQS01			
MQS02			
Process			
MPR01			
MPR02			
MPR03			
Component Allocation			
MCA01			
MCA02			
Physical Fault Management			
MPF01			
Integrating Multiple Views			
MVI01			
MVI02			
MVI03			
MVI04			
MVI05			
MVI06			
MVI07			
MVI08			
MVI09			
MVI10			
MVI11			
MVI12			
MVI13			
MVI14			

Need Coordination Plan Inputs For Coverage Of Additional Existing Requirements

Challenge Problems (cont)

- **Increasing Depth**
  - **Increased integration of views, analyses, and tools**
  - **Increased separation of system requirements and design specifications**
  - **Increased automation of system configuration**
  - **… *both related to John's control system program analogy***

Further Discussion In Breakout Session

Challenge Problems (cont)

- **Increasing Alignment With Commercial Technologies**
  - **Need To Ensure That**
    - **MoBIES is complementary to commercial technology investments**
    - **MoBIES technologies can be integrated with commercial technologies to provide end-to-end development capabilities**
  - **Notable Examples For Boeing OEP Are**
    - **OMG MDA and UML 2.0**

Interface Definition Status

- **Application Component Library (ACL – Boeing)**
  - **v1.0, 15-Jan-02,** *midterm baseline*
  - **v1.1, 03-Jun-02,** *refined some default values, mandatory and optional receptacles combined into single attribute, processor resources broken into two separate attributes, Configuration_Info added to allow specification of component variabilities*
  - **v1.2, Sep-02,** *add state model requirements, refine processor restrictions, handle inheritance of facets*
- **Instrumentation Interface (IIF – Boeing)**
  - **v2.0, 20-Jun-02,** *update for Build 2.0, timers, scheduler scope*

Interface Definition Status (cont)

- **OEP Configuration Interface**
  - **v2.0 released with Build 2.0, 24 June 2002,** *internal component configurability*
  - **v1.6 released 29 March 2002,** *support for concurrency and other Build 1.6 additions*
- **Model Editor (ME – Vanderbilt)**
  - **v1.1 released 19 February**
- **Analysis Interface Format (AIF – Vanderbilt)**
  - **No updates this period**

Experimentation Plans

- **Next Formal Experimentation Phase Planned For 2003**
  - **Experimentation planning in Q1**
  - **Experimentation execution in Q2**
- **Incremental Experimentation Feedback Provided As Needed**
  - **Driven by Phase I Applied Researchers**

10: Technology Transition/Transfer

- **Future Combat Systems**
  - Engaged with FCS designers
  - Adopted meta-modeling approach used in Boeing Challenge Problems
  - Actively working with them on architectural modeling and meta-modeling
- **Other Transition Targets**
  - Bold Stroke-based and other production military programs
- **…And Transition Activities**
  - Programs have been briefed on MoBIES and other IXO programs
  - Programs have been consulted for challenge problems to foster interchange and provide opportunity to influence program

11: Program Issues

- None

Summary

- **Reflecting On First Two Years of MoBIES**
  - **Culminating in mid-term experiments**
    - **Entailed significant effort across the board**
    - **Greatly accelerated maturation of integrated development capabilities**
    - **Captured concrete data indicating benefits of model-based integration, even for relatively small systems**
- **Looking Ahead To Next Two Years**
  - **Need to pause and assess progress, chart future directions**
    - **Move on to more realistic systems**
    - **Broaden and deepen capabilities**
    - **Synergize work with commercial industry**